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U.S. Naval Observatory Press Release

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Star Companions Rule!

An astronomer at the U.S. Naval Observatory (USNO) in Washington, DC has discovered during the course of searching through catalogs of nearby stars that the number of stars with companions (stellar and/or planetary) is far greater than had been previously thought. This implies that stars that are truly “single” in space are very rare indeed, amounting to perhaps only five percent of the stellar population of the Milky Way Galaxy. Dr. Rob Olling will present his findings in a poster paper at the 205th Meeting of the American Astronomical Society this morning.

Dr. Olling was examining data in a number of newly available star catalogs when he noticed that the number of “binary” systems among stars whose distances were known from precise measurement of their parallaxes was unusually high; as many as 95 percent of these nearby systems showed signs of having either planetary or stellar companions, or both. Analyzing more distant stars in the catalogs, Dr. Olling was able to determine that the number of detectable systems decreased strongly with distance and brightness, inferring that the population of known binary stars must therefore be constrained by process of discovery rather than physical attributes.

It has long been known that the majority of stars that are visible in the night sky are binary or multiple-component systems. Many of these stars can be resolved in modest amateur telescopes, and the study of binary stars was a mainstay of astronomy for hundreds of years. As new instruments and observing techniques were introduced to astronomy, the number of binary stars grew. Systems that could not be resolved optically betrayed their binarity to the spectroscope and photometer. Interferometers, such as the “Speckle Interferometer” installed on the venerable 66-cm (26-inch) Great Equatorial Refractor telescope at the USNO in Washington, DC or the dedicated Navy Prototype Optical Interferometer (NPOI) deployed by USNO, the Naval Research Laboratory, and Lowell Observatory at the Anderson Mesa site in Arizona further populated the number of known binaries. Until now it has been generally accepted that between 50 to 60 percent of all stars in the Galaxy were binary or multiple-component systems.

In 1997 the European Space Agency released the Hipparcos Catalog, consisting of some 118,000 stars whose precise positions and parallaxes were measured by their

HIPPARCOS astrometric satellite. Dr. Olling combined these data with those from a number of other recently issued survey catalogs and selected a subset of nearby stars which resemble the Sun. He selected these stars because a study carried out in 1991 by Drs. Duquennoy & Mayor, using primarily radial velocities complemented with older photographic and visual catalogs, indicated that this particular grouping showed a binary population of about 50 percent. Dr. Olling's findings indicate that the newer data show a binary population that is closer to 95 percent of the sampled stars. Furthermore, randomly selected stars of other distances and spectral types indicate that this trend is not limited to just one type of star or that such stars just happen to be preferentially distributed in the near-solar Galactic neighborhood.

"Given that the sample most favorable for the detection of companions has a multiplicity fraction of 95%, I suggest that in fact all stars are part of a multiple system." Dr. Olling says.

This finding has a number of important implications concerning star formation. In particular, it indicates that when stars form, companions in the form of other stars, "brown dwarfs", or massive planets are a necessary by-product of the process. Long-term studies of these systems may allow the determination of the orbital elements of the companions, which will then be able to verify physical models of many different types of stars. It will also help to find appropriate candidate stars to look for planets with the potential to support life-forms. Such planets should be in a stable orbit around the parent star, with the orbit in the "habitable zone" where the planets are not too warm (like Venus) and not too cold (like Mars). Were such planets to be found orbiting in binary systems, the number of possible "stable orbits" is much reduced due to the gravitational pull of the *two* stars. Thus, if these stable orbits are calculated to not overlap with the habitable zone, this particular binary system can be skipped by the SIM PlanetQuest and Terrestrial Planet Finder (TPF) missions that will search for terrestrial-class planets that might harbor life-forms.

Finally, Dr. Olling's results indicate that all stars combined weigh about 20 percent more than previously thought. As a consequence, the amount of dark matter in the Milky Way must be 20 percent smaller because the sum of dark and stellar matter is known to be constant.